"In-Situ Sampling and Characterization of Naturally Occurring Marine Methane Hydrate Using the D/V JOIDES Resolution."

DOE COOPERATIVE AGREEMENT: DE-FC26-01NT41329

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Name of Submitting Organization: Joint Oceanographic Institutions

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DISCLAIMER

ABSTRACT

The primary accomplishments of the JOI Cooperative Agreement with DOE/NETL in this quarter were to finalize budgets and operational plans for Phase 2 of this cooperative agreement based on the scheduling of a scientific ocean drilling expedition to study marine methane hydrates along the Cascadia margin, in the NE Pacific as part of Integrated Ocean Drilling Program (IODP) Expedition 311 using the R/V JOIDES Resolution.

The proposed statement of work for Phase 2 includes three primary tasks: (1) research management oversight, provided by JOI; (2) mobilization, deployment and demobilization of pressure coring and core logging systems, through a subcontract with Geotek Ltd., who will work with Fugro and Lawrence Berkeley National Laboratory to accomplish some of the subtasks; and, (3) mobilization, deployment and demobilization of a refrigerated container van that will be used for degassing of the Pressure Core Sampler and density logging of these pressure cores, through a subcontract with the Texas A&M Research Foundation (TAMRF). Additional operational details regarding the implementation of these tasks is provided in the following sections of this report.

Planning meetings took place in College Station, TX and in The Woodlands, TX during the reporting period (pre-award) to prepare for deployments that would take place in August 2005. These meetings served to coordinate preparations for deployment, look for gaps in the implementation plans and assign responsibilities for specific tasks among the groups funded by this cooperative agreement. The DOE/NETL Program Manager, Bill Gwilliam, and Ray Boswell, Acting Technology Manager – Methane Hydrates, were kept informed about progress and requirements to meet the deployment schedule.

IODP Expedition 311 activities officially began when the JOIDES Resolution arrived in Balboa, Panama and dropped anchor at 0029 hr 28 August 2005 officially ending IODP Expedition 309 and beginning Expedition 311. The transit from Panama to Oregon was completed by the afternoon of September 15, 2005. The Expedition 311 staff scientist and science participants did not board the ship in Astoria, Oregon on September 16, but significant amounts of preparatory work was accomplished by the IODP-USIO technical and engineering staff during the transit from Panama to Oregon.

Following completion of all dockside preparatory work, the JOIDES Resolution departed Astoria at 10:00 hr on 19 September. During the transit to the first site, preparation continued for deployment of the Pressure Core Sampler (PCS) and assistance was provided with readying the APCT/APCT3 and DVTP temperature tools. In addition, the PCS gas manifold system was installed and plumbed in the PCS van and a dry run of PCS core handling was conducted with key participants. The transit was also used to continue to prepare the vans and laboratories for coring. The installation of the IR camera track on the catwalk was completed. The marine specialists were trained in the use of the Parr pressure vessels for gas hydrate sampling and in the use of the IR camera track.

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INTRODUCTION

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The various Phase 2 tasks of this cooperative agreement included the following:

Task 1-0 – Research Management Oversight: JOI provide management oversight of all subcontracts during the reporting period by coordinating and hosting several planning meetings to refine objectives and options to mobilize equipment to the JOIDES Resolution for IODP Expedition 311 in the face of anticipated late arriving funding from DOE-NETL relative to the start of the expedition. JOI established two sole-source subcontracts to provide appropriate equipment and the technical and engineering staff to deploy refrigerated vans and the HYACINTH pressure coring systems and subsystems on IODP Expedition 311. JOI finalized the statements of work for all subcontracted work and conducted oversight of all tasks related to these subcontracts.

Task 2-0 – Pressure Coring and Pressure Core Logging Systems: JOI established a primary subcontract with Geotek Ltd., who worked with Fugro (Subtask 2-1), to mobilize and deploy the HYACINTH pressure coring systems and associated core logging subsystems aboard the JOIDES Resolution for IODP Expedition 311 (Cascadia Margin Hydrates) while providing adequate engineering and technical support for the operation of these coring tool and measurement systems.

Task 3-0 – PCS Core Logging and Infrared Thermal Imaging Measurements: JOI established a separate subcontract with Texas A&M Research Foundation (TAMRF) to procure, outfit and deploy a refrigerated van that will be used to house PCS pressure core logging equipment (equipment provided separately by Geotek, Ltd. under the previously described subcontract with JOI) and degassing equipment used in the analysis and characterization of IODP PCS pressure cores.

EXECUTIVE SUMMARY

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IODP Expedition 311 activities officially began when the JOIDES Resolution arrived in Balboa, Panama and dropped anchor at 0029 hr 28 August 2005 officially ending IODP Expedition 309 and beginning Expedition 311. The transit from Panama to Oregon was completed by the afternoon of September 15, 2005. The Expedition 311 staff scientist and science participants did not board the ship in Astoria, Oregon on September 16, but significant amounts of preparatory work was accomplished by the IODP-USIO technical and engineering staff during the transit from Panama to Oregon.

Following completion of all dockside preparatory work, the loading of supplies and the boarding of the scientific party, the JOIDES Resolution departed Astoria at 10:00 hr on 19 September. During the transit to the first site, preparation continued for deployment of the Pressure Core Sampler (PCS) and assistance was provided with readying the APCT/APCT3 and DVTP temperature tools. In addition, the PCS gas manifold system was installed and plumbed in the PCS van and a dry run of PCS core handling was conducted with key participants. The transit was also used to continue to prepare the vans and laboratories for coring. The installation of the IR camera track on the catwalk was completed. The marine specialists were trained in the use of the Parr pressure vessels for gas hydrate sampling and in the use of the IR camera track.

EXPERIMENTAL

The primary accomplishments of the JOI Cooperative Agreement with DOE/NETL in this quarter were to refine budgets and operational plans for Phase 2 of this cooperative agreement and to mobilize equipment and personnel for shipboard deployment of capabilities required, based on the schedule of IODP Expedition 311, which is a scientific ocean drilling expedition to study marine methane hydrates along the Cascadia margin, in the NE Pacific as part of the Integrated Ocean Drilling Program (IODP) using the R/V JOIDES Resolution.

The proposed statement of work for Phase 2 includes three primary tasks: (1) research management oversight, provided by JOI; (2) mobilization, deployment and demobilization of pressure coring and core logging systems, through a subcontract with Geotek Ltd., who will work with Fugro and Lawrence Berkeley National Laboratory to accomplish some of the subtasks; and, (3) mobilization, deployment and demobilization of a refrigerated container van that will be used for degassing of the Pressure Core Sampler and density logging of these pressure cores, through a subcontract with the Texas A&M Research Foundation (TAMRF). Additional operational details regarding the implementation of these tasks is provided in the following sections of this report.

IODP Expedition 311 Preparatory Work on the *JOIDES Resolution*

IODP Expedition 311 activities officially began when the JOIDES Resolution arrived in Balboa, Panama and dropped anchor at 0029 hr 28 August 2005 officially ending IODP Expedition 309 and beginning Expedition 311. The transit from Panama to Oregon was completed by the afternoon of September 15, 2005. The Expedition 311 staff scientist and science participants did not board the ship in Astoria, Oregon on September 16, but significant amounts of preparatory work was accomplished by the IODP-USIO technical and engineering staff during the transit from Panama to Oregon.

Once underway, technicians began the placement of plywood to enclose the catwalk for assembly of the infrared (IR) track and fabricated inserts for shipping pressure vessels. The IR track was initially installed on the catwalk during the transit, while final completion of the installation was accomplished during the Astoria port call once the GEOTEK crew came aboard to fine-tune the installation. IODP-USIO staff undertook the construction of tables and furniture designed for use in the new refrigerated van and all laboratories were prepared for the Cascadia gas hydrate expedition.

A vertical ice bath for temporary storage of pressurized core barrels and a jib crane to lift pressurized core barrels from the rig floor to the Lab Stack roof for processing in a refrigerated van were assembled and installed. The rails for the ice bath were welded in place on the moon pool doors. The ice bath, constructed of 10-3/4" casing with 4" of foam insulating material, was suspended on the rails into the moon pool and aligned with the middle core barrel shuck on the rig floor. The ice machine, dedicated to keeping the ice bath filled, was located in the Subsea Shop. A chute structure was designed to be

mounted in the Subsea Shop floor hatch opening and extend down approximately 15 feet to the vertical ice bath. The chute was fabricated from 10" diameter PVC pipe that came onboard in Astoria. The jib crane pedestal was welded to the Lab Stack roof and the crane assembled and made operational. The crane was positioned on the inboard aft corner of the Lab Stack roof. The reach of the crane was designed to allow pressurized core barrels to be hoisted from the rig floor to the Lab Stack roof and quickly moved into a refrigerated van for degassing and logging.

An I-beam support structure was installed on the lab stack roof to provide a base for storage of the two 250 gallon and one 400 gallon liquid nitrogen supply tanks. In addition, two 20 ft. reefer vans, which will be used for pressure core processing and analyses, were installed on the lab stack roof and core tech shop roof. Schlumberger LWD/MWD tools and equipment were loaded aboard as well as the Fugro Pressure Corer and the HYACE Rotary Corer.

The following tools were received and loaded onboard in Astoria, OR: four calibrated methane tools (two each APCM and PCSM) with tool box, three PCS pressure barrels and two actuators with tool boxes, 10" PVC pipe hardware for ice chute, two calibrated DVTPPs, two DVTP calibrated probes, four calibrated PCS pressure transducers with one laptop for the gas sampling manifold, two high pressure hoses for PCS gas sampling manifold. The laptop for the gas sampling manifold, and the laptop for standpipe 8 Hz monitoring will be delivered at the LWD/MWD boat transfer.

Following completion of all dockside preparatory work, the loading of supplies and the boarding of the scientific party, the JOIDES Resolution departed Astoria at 10:00 hr on 19 September. During the transit to the first site, preparation continued for deployment of the Pressure Core Sampler (PCS) and assistance was provided with readying the APCT/APCT3 and DVTP temperature tools. In addition, the PCS gas manifold system was installed and plumbed in the PCS van and a dry run of PCS core handling was conducted with key participants. The transit was also used to continue to prepare the vans and laboratories for coring. The installation of the IR camera track on the catwalk was completed. The marine specialists were trained in the use of the Parr pressure vessels for gas hydrate sampling and in the use of the IR camera track.

RESULTS AND DISCUSSION

OPERATIONAL SUMMARY

Transit to IODP Site U1325 (proposed site CAS-02C)

The 188 nmi transit to Site U1325 was completed in 19.5 hrs at an average speed of 9.6 knots. Upon arrival on site, the vessel switched to dynamic positioning (DP) mode, settling on location at 07:25 on 20 September 2005.

IODP Hole U1325A (proposed site CAS-02C)

The Logging While Drilling and Measurements While Drilling (MWD/LWD) tool string was assembled and the drill string run to the seafloor. During function testing of the tool string, a leak in the top drive swivel wash pipe packing was discovered, which required 1.5 hrs to repair. Hole U1325A was spudded at 23:10 hr establishing a seafloor depth of 2212.0 mbrf. The hole was logged to 350 mbsf without incident and within the prescribed protocol guidelines, requiring no corrective actions. After displacing the hole with 105 barrels of 10.5 ppg sepiolite mud, the drill string was tripped to the rig floor for the downloading of LWD/MWD logging tools while transiting in DP mode to Site U1326. The bit cleared the rotary table at 05:15 hr, officially ending Hole U1325A.

IODP Hole U1326A (proposed site CAS-03C)

After completing data download and tool change out, the LWD/MWD BHA was deployed, function tested, and the drill string was tripped to the seafloor. Hole U1326A was spudded at 14:45 hr on 22 September tagging the seafloor at 1839.0 mbrf. After a controlled rate spud-in to maintain the quality of the near-surface LWD/MWD logs, Hole U1327A was advanced at a relatively high realtime penetration rate of 50 m/hr. The hole was drilled to a total depth of 300 mbsf, completing logging operations at 04:15 hr on 23 September 2005. After displacing the hole with 98 barrels of 10.5 ppg sepiolite mud, the drill string was pulled clear of the seafloor ending Hole U1326A.

IODP Hole U1327A (proposed site CAS-01B)

The *JOIDES Resolution* transited 8.5 nmi to Site U1327 in DP mode and Hole U1327A was spudded at 18:30 hr on 23 September 2005, establishing a seafloor depth of 1333.0 mbrf. The same controlled spud-in, followed by optimization of drilling parameters to maintain a 50 m/hr penetration rate was followed in Hole U1327A. Logging operations were completed at a total depth of 300 mbsf at 08:15 hr on 24 September 2005. After displacing the hole with 98 barrels of 10.5 ppg sepiolite mud, the drill string was pulled clear of the seafloor ending Hole U1327A.

IODP Hole U1328A (proposed site CAS-06A)

The ship was moved in DP mode to Site U1328, arriving at 13:00 hr on September 24, 2005. Prior to spudding Hole U1328A, a bottom-camera survey was conducted to ensure that no chemosynthetic communities were present. Hole U1328A was spudded at 15:55 hr, tagging the seafloor at 1279.0 mbrf. Spud and drilling parameters remained unchanged from the previous site, and like all previous sites, no corrective action was required within the prescribed drilling protocol guidelines. The total depth of 300 mbsf was reached at 04:15 hr on 25 September 2005. After displacing the hole with 98 barrels of 10.5 ppg sepiolite mud, the drill string was recovered back to the rig floor with the bit clearing the rotary table at 11:00 hr on 25 September 2005, officially ending Hole U1328A. During the pipe trip, the ship was offset 9.9 nmi in DP mode to Site U1329 (CAS-05D). Data download and LWD/MWD tool preparation continued during the DP move to Site U1329.

PRELIMINARY SCIENTIFIC RESULTS

The downhole-logging program that was executed during Expedition 311 was specifically designed to assess the presence and concentration of gas hydrates on the Cascadia accretionary prism. LWD/MWD operations are being conducted prior to coring each site. The LWD/MWD tools measure in-situ formation properties with instruments that are located in the drill collars immediately above the drill bit. LWD/MWD logging tools were deployed at four sites (Sites U1325, U1326, U1327, and U1328); with an additional planned fifth logging site (Site U1329). The LWD/MWD tools used during Expedition 311 include the GeoVISION, EcoScope tool, TeleScope MWD tool, ProVISION NMR tool, and the adnVISION tool. The use of these tools prior to coring was planned to identify intervals of interest where special tools (such as the PCS or the HYACINTH pressure coring tools) could be used to attempt to recover gas hydrate samples. In addition to providing a large array of data and helping the strategy for the deployment of special tools, the LWD/MWD tools allowed the monitoring of drilling performance and the reaction of the formation as the drill string advanced. The Annular Pressure While Drilling (APWD) sensor on the EcoScope tool made it possible to monitor bottom hole fluid pressure. This tool allows detecting downhole events, such as building formation pore pressures, liquid influx or gas flows, which could require immediate action to guarantee the safety of the tools and of the operations.

CONCLUSION

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LIST OF ACRONYMS AND ABBREVIATIONS

APC	Advanced Piston Corer
APC-M	Advanced Piston Corer-methane tool
APC-T	Advanced Piston Corer-temperature tool
BHA	Bottom Hole Assembly
BSR	Bottom Simulating Reflector
DOE	Department of Energy
DVTP	Davis Villinger Temperature Probe
DVTP-P	Davis Villinger Temperature Probe with Pressure
FMMG	Fugro-McCleland Marine Geosciences
FPC	Fugro Pressure Corer
GHSZ	Gas Hydrate Stability Zone
HRC	HYACE Rotary Corer
HYACE	Hydrate Autoclave Coring Equipment
HYACINTH	Deployment of HYACE tools In New Tests on Hydrates
IODP	Integrated Ocean Drilling Program
IR-TIS	Infrared Thermal Imaging System
JOI	Joint Oceanographic Institutions
JOIDES	Joint Oceanographic Institutions for Deep Earth Sampling
LDEO	Lamont Doherty Earth Observatory (Columbia University)
L/L	Liters per Liter
LTC	Laboratory Transfer Chamber
LWD	Logging While Drilling
MBRF	Meters Below Rig Floor
MBSF	Meters Below Sea Floor
MH	Methane Hydrate
MPa	Mega-Pascals
MSCL-V	Multi-Sensor Core Logger – Vertical
MWD	Measurements While Drilling
NETL	National Energy Technology Laboratory
NSF	National Science Foundation
ODP	Ocean Drilling Program
PCS	Pressure Core Sampler
PSI	Pounds per Square Inch
RAB	Resistivity at the Bit
RCB	Rotary Core Barrel
R/V	Research Vessel
TAMU	Texas A&M University
XCB	Extended Core Barrel